

chosen, clearly and yet artistically drawn, and excellently reproduced. The sources from which they were derived are indicated in some cases only, although a number of the unacknowledged figures will be familiar to the readers of zoological literature.

There is an unduly large number of misprints in the book, especially in the lettering and the inscriptions of the various figures. There is no bibliography.

G. E. S.

#### LIQUID CRYSTALS.

*Flüssige Kristalle: sowie Plastizität von Kristallen im Allgemeinen, Molekulare Umlagerungen und Aggregatzustandänderungen.* By Dr. O. Lehmann. Pp. vi+264; atlas of 39 photographic plates. (Leipzig: W. Engelmann, 1904.) Price 1l. net.

WHATEVER may be the ultimate conclusion of physicists concerning the explanation of the interesting phenomena described by the author of this volume under the term "liquid crystals," and however diverse may be the views entertained as to their bearing on current molecular theories, there can be no difference of opinion as to the value of the work before us, in which the description of these phenomena is so clearly set forth and so fully illustrated.

It was in 1889 that Dr. Otto Lehmann, the professor of physics in the Technical High School of Karlsruhe, and the author of many memoirs dealing with the application of microscopical methods to physical research, first suggested the use of this term "liquid crystals." The acceptance of the term by physicists and crystallographers has not been by any means universal or unqualified, and in certain quarters it has been received with something like ridicule. The general attitude which, with our present knowledge of the subject, it may be wise to preserve was well expressed by Prof. Miers in an article upon the subject which he contributed to *Science Progress* of January, 1897:—

"It will be wise to retain the names crystal and crystalline in their old significations, rather than to extend them so as to include the birefringent liquids whose existence has been established by Lehmann. It may be that these remarkable drops are examples of liquid matter in which particles while free to move are compelled to preserve the same orientation, and differ in this respect from ordinary liquids. But whether this peculiarity of structure, whatever may be its nature, is really analogous to that of solid crystals is a question in which it will be better not to commit ourselves to an answer by applying the same name to both until more is known about the structure both of liquids and solids."

It is not probable that the present volume will materially affect the cautious verdict pronounced by Prof. Miers, seven years ago, on behalf of crystallographers and physicists, for although many new and interesting observations are added to those announced in Prof. O. Lehmann's earlier memoirs, there is nothing in the work before us which can be regarded as supplying absolutely conclusive or crucial evidence on the subject.

In his original memoir Dr. O. Lehmann was able to confirm the observations of Reinitzer and of Gatter-

mann that certain organic compounds possess two melting points, and he showed that, at temperatures between these two melting points, the substances, though possessing the freedom of motion of liquids, affect polarised light like crystals, and, like crystals, exhibit the phenomenon of dichroism.

In the treatise under review the list of organic compounds exhibiting these remarkable properties is considerably augmented, though all the newly described substances are closely allied in their chemical nature to those previously known. Dr. O. Lehmann proposes to divide them into two classes—"Flüssende Krystalle," in which between the two melting points the crystal retains something of its original form, modified by the rounding of the edges and angles, though two of them brought into contact have sufficient mobility to enable them to unite; and true "Flüssige Krystalle," in which, although the original crystal form is wholly lost and the substance forms rounded and very mobile drops, the double refracting and other optical properties of the crystal are nevertheless retained. It is, however, admitted by Lehmann that the distinction between these two classes of substances is neither very definite nor of fundamental character.

It is impossible in the space at our command, even if such a course were desirable, to enter upon the discussion of the physical relations of solids and liquids which the author bases on his observations. On many points he arrives at conclusions in marked opposition to those maintained by Butschli, Nernst, Ostwald, and other physicists.

By the aid of the beautiful photographs, so admirably reproduced in the plates, and the numerous diagrammatic figures in the text, the reader will find it possible to follow and understand the very interesting observations of the author. The value of the photographs would certainly have been increased if, in every case, the degree of magnification had been indicated; and a detailed description of the plates with a good index would have added to the value of this very important treatise.

#### THE TESTING OF STEELS.

*Relations between the Effects of Stresses Slowly Applied and of Stresses Suddenly Applied in the Case of Iron and Steel. Comparative Tests with Notched and Plain Bars.* By Pierre Breuil. Pp. vii+152+23 plates. *Jour. Iron and Steel Inst. Supplement*, vol. lxv. (London: Iron and Steel Institute, 1904.)

CONSIDERATION of the subject of tests and testing should be approached with a very open mind, not only because it is the common meeting ground of the engineer and the metallurgist, but because it is a difficult subject of compromise, where the selected method is practically never ideal. Steel is necessarily as often submitted to tests which it is hoped will give a measure of its qualities as to those stresses to which it will be exposed in practice. The latter is the practical ideal test short of behaviour in actual use which is seldom feasible, as often the finish of the test would require to be left to another generation. Thus the real purpose of tyres or rails is to wear well without breaking; nevertheless, they are often tested

to destruction by a falling weight, and the material invariably so in tension.

Again, some members of a girder are in tension, others in compression, while practically all are passed on the measure of their qualities given by the tensile test. For a certain elastic limit and maximum stress the highest elongation and reduction in area are assumed to indicate the toughest steel. For materials where great toughness is of paramount importance, the tensile, cold bending, and even quenched bending are typical tests, and on the whole they have served well; but in perhaps one case out of many thousands mild steel snaps in use without elongation after satisfying all ordinary tests for ductility. Cases such as these, which, though rare, may entail great loss of life or, as in the case of certain parts of vessels of war, might mean disaster to a whole crew, have probably been the exciting cause which has set men on the search for some means of detecting these rare cases where the risk would justify the extra expense.

It is evident that this case of one in thousands cannot be touched by experiments on (to quote the author) "no less than five tons of various kinds of specially manufactured metal," for that particular one must be found by the real test of failure in ordinary use and experiments made on it. The author's unconditional advocacy of the plain tensile and bending tests, and scornful reference to the others, indicates either that he is happy in a paradise which need not be specified or that many eminent practical and scientific engineers and metallurgists are at the present day unnecessarily anxious. No one would advocate the abolition of the tensile tests, as they are required for the engineer's calculations, and are generally a sufficient guarantee of trustworthiness. The sole contention is that in certain special cases something more is necessary.

The reviewer has been engaged during the last two years with Prof. Arnold on this very matter, subjecting steels known to have failed in use to Arnold's alternating stress and other tests with a view to find a practical system which will eliminate those possessing this curious brittleness. Two steels, one the best modern make of boiler plate, the other a steel which gave passable tensile tests and bent close double without a sign of distress, yet broke during the official hydraulic tests, gave very different results under the special alternating stress test. These statements having reference to facts, no study of comparative tests on specially manufactured steels can strike at the root of the matter. Although to certain mechanical testers and men of figures the variations in some of the results from the newer methods may look somewhat formidable when presented as percentages, the fact remains that these tests have picked out dangerous steels which had satisfactorily passed tensile and bending tests. Therefore some such new system of testing claims the special attention of the designer of high-speed and other work where large issues, and possibly loss of life, would be involved by the failure of a member.

This volume is the Carnegie gold medal thesis for the year, and deals with experiments on tensile tests, on plain and on notched bars, slowly applied. Many

figures are given on the effect of size and form of notch. Plain and nicked bends slowly applied and as impact tests are also considered, but excuse is made that the subject is so large that it could not be adequately dealt with. The present writer is firmly convinced that it would count more for real solid progress if the Carnegie scholars were encouraged to take a smaller field and explore it more thoroughly, for to a steel metallurgist a brief paper embodying definite and concrete results is far more valuable than a voluminous and indefinite thesis. It is worthy of note that the 0.7 per cent. and 0.4 per cent. carbon steels contained 0.34 per cent. and 0.22 per cent. silicon respectively, amounts that would debar their acceptance under British specifications, not on account of the tensile tests, but because of their suspected greater liability to break under vibration.

A. MCW.

*CHEMISTRY OF THE PROTEIDS.*  
*Chemie der Eiweisskörper.* By Dr. Otto Cohnheim.

Zweite Auflage. Pp. xii + 313. (Brunswick: Vieweg und Sohn, 1904.) Price 8.50 marks.

ALTHOUGH only four years have elapsed since the first edition of this work appeared, the great advances made in our knowledge of the chemistry of the proteids have necessitated a considerable revision of the book. The author, however, has found it possible to avoid any enlargement of the work by altering the order of subjects treated, and by stating the facts more concisely than in the previous edition. Some of the alterations in arrangement appear somewhat difficult to justify. Thus, for example, in the earlier edition the physical characters were dealt with prior to the consideration of the more purely chemical properties of the proteids, while in this edition the order is reversed. As the first edition has been already reviewed in NATURE, only a brief account of the chief additions to the second will be necessary.

Perhaps the most important recent additions to our knowledge have consisted in the more complete separation and identification of the products of the hydrolytic decomposition of the proteids. Dr. Cohnheim gives an excellent account of the results obtained in this field by E. Fischer and his pupils by means of the method of fractional distillation under reduced pressure of the ethyl esters of the amino-acids. This method has secured a much more complete separation of the amino-acids than any methods previously employed, although the results obtained are still far from quantitative. By its use E. Fischer has been able to prove that certain amino-acids, namely,  $\alpha$ -amino-valerianic and  $\alpha$ -amino- $\beta$ -oxypropionic acids, are much more widely distributed products of proteid hydrolysis than has been hitherto supposed. Fischer has also succeeded in separating two acids, namely,  $\alpha$ -pyrrolidin-carboxylic and oxy- $\alpha$ -pyrrolidin-carboxylic acids, which were hitherto unknown as products of the decompositions of proteids. The latter acid was isolated from the residue remaining after distilling off the esters of the amino-acids. A full account is also given of recent work on the more complete chemical characterisation of the amino-acids, including the separation of several into optically active isomers.